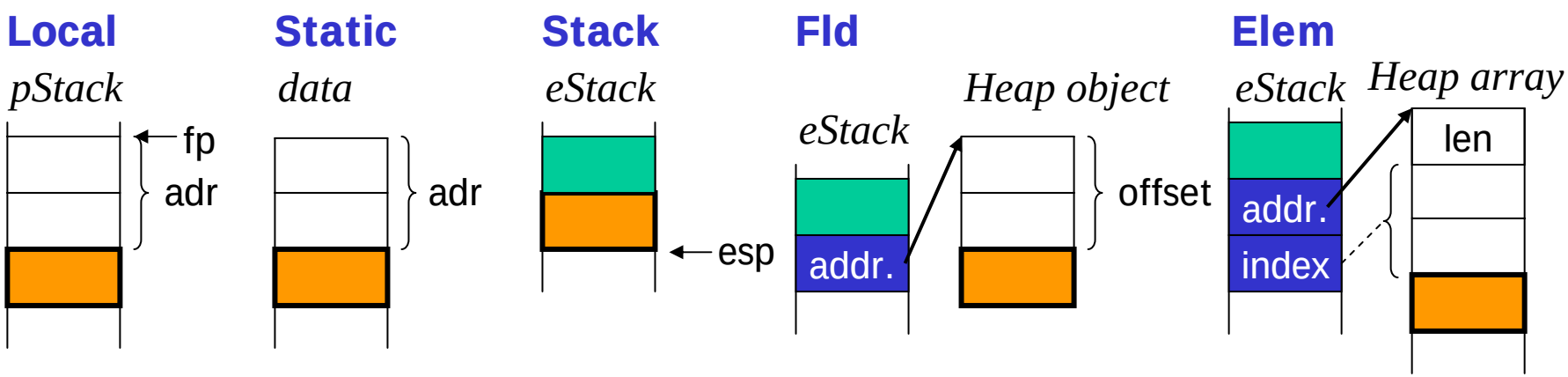
Codeitem-Klasse *Item*

```
class Item {
    public static final int   // Item Art
        Con=0, Local=1, Static=2, Stack=3, Fld=4, Elem=5, Meth=6;
    public int kind;
    public Struct type;    // Typ des Operanden
    public Obj obj;        // Meth: Methodenobjekt aus Symbolliste
    public int adr;        // Con: Wert; Local, Static, Fld, Meth: Adresse
}
```



Beispiel-Grammatik für Codeerzeugung

Assignment = Designator "=" Expr .

Expr = Term { "+" Term } .

Term = Factor { "*" Factor } .

Factor = number | Designator.

Designator = ident ["." ident | "[" Expr "]"].

Sem. Aktionen für Codeerzeugung (1)


```
void Designator() {
   check(Token.ident);

   if (sym == Token.period) {
      scan();

      check(Token.ident);


   } else if (sym == Token.lbrack) {
      scan();

      Expr();


   }

}
```

Sem. Aktionen für Codeerzeugung (1)


```
Item Designator() {
   check(Token.ident);
   Item x = new Item(Tab.find(t.str));
   if (sym == Token.period) {
      scan();

      check(Token.ident);
      Obj obj = Tab.findField(t.str, x.type);
      x.kind = Item.Fld; x.type = o.type; x.adr = o.adr
   } else if (sym == Token.lbrack) {
      scan();

      Item y = Expr();

      x.kind = Item.Elem; x.type = x.type.elemType;
   }
   return x;
}
```

Sem. Aktionen für Codeerzeugung (1)


```
Item Designator() {
   check(Token.ident);
   Item x = new Item(Tab.find(t.str));
   if (sym == Token.period) {
      scan();
      Code.load(x);
      check(Token.ident);
      Obj obj = Tab.findField(t.str, x.type);
      x.kind = Item.Fld; x.type = o.type; x.adr = o.adr
   } else if (sym == Token.lbrack) {
      scan();
      Code.load(x);
      Item y = Expr();
      Code.load(y);
      x.kind = Item.Elem; x.type = x.type.elemType;
   }
   return x;
}
```

x.type.kind == Struct.Class

x.type.kind == Struct.Arr

y.type == Tab.intType

Klasse *Item* – Konstruktor *Item(Obj)*


```
Item(Obj o) {
    type = o.type; adr = o.adr;
    switch (o.kind) {
        case Obj.Con:
            kind = Con; break;
        case Obj.Var:
            if (o.level == 0) kind = Static; else kind = Local; break;
        case Obj.Meth:
            kind = Meth; obj = o; break;
        default:
            Parser.Errors.error("CREATE_ITEM"); throw new Error();
    }
}
```

Klasse *Code* – Hilfsmethode *load*

```
void load(Item x) {
    switch (x.kind) {
        case Item.Con:
            if (x.type == Tab.nullType) put(const_n + 0);
            else loadConst(x.adr); break;
        case Item.Local:
            if (0 <= x.adr && x.adr <= 3) put(load_n + x.adr);
            else { put(load); put(x.adr); } break;
        case Item.Static:
            put(getstatic); put2(x.adr); break;
        case Item.Stack:
            break;  // nothing to do (already loaded)
        case Item.Fld:
            put(getfield); put2(x.adr); break;
        case Item.Elem:
            if (x.type.kind == Struct.Char) put(baload);
            else put(aload); break;
        default:
            Parser.Errors.error("CODE_LOAD"); throw new Error();
    }
    x.kind = Item.Stack;
}
```

Sem. Aktionen für Codeerzeugung (2)


```
Item Factor() {
    Item x;
    if (sym == Token.number) {
        scan();
        x = new Item(Item.Con, t.val, Tab.intType);
    } else {
        x = Designator();
    }
    return x;
}
```

```
Item Term() {
    Item x = Factor();
    while (sym == Token.times) {
        scan();
        Code.load(x);
        Item y = Factor();
        Code.load(y);
        Code.put(Code.mul);
    }
    return x;
}
```

x.type == Tab.intType &&
y.type == Tab.intType

Sem. Aktionen für Codeerzeugung (3)


```
Item Expr() {
    Item x = Term();
    while (sym == Token.plus) {
        scan();
        Code.load(x);
        Item y = Term();
        Code.load(y);
        Code.put(Code.add);
    }
    return x;
}
```

x.type == Tab.intType &&
y.type == Tab.intType

```
void Assignment() {
    Item x = Designator();
    check(Token.assign);
    Item y = Expr();
    Code.assign(x, y);
}
```

y.type.assignableTo(x.type)

Klasse *Code* – Hilfsmethode *assign*


```
void assign(Item x, Item y) {
    load(y);
    switch (x.kind) {
        case Item.Local:
            if (0 <= x.adr && x.adr <= 3) put(store_n + x.adr);
            else { put(store); put(x.adr); } break;
        case Item.Static:
            put(putstatic); put2(x.adr); break;
        case Item.Fld:
            put(putfield); put2(x.adr); break;
        case Item.Elem:
            if (x.type.kind == Struct.Char) put(bastore);
            else put(astore); break;
        default:
            Parser.Errors.error("NO_VAR");
    }
}
```

Klasse *Struct* – Hilfsmethoden


```
boolean isRefType() {
    return kind == Class || kind == Arr;
}

boolean typeEqual(Struct other) {
    if (kind == Arr) {
        return other.kind == Arr && elemType.typeEqual(other.elemType);
    } else {
        return this == other;     // must be same type Obj node
    }
}
```

Hinweis: Die Methode **equals**(Struct other) der Klasse Struct wird nur von den JUnit-Testfällen verwendet und prüft **nicht** die korrekte semantische Typgleichheit!

Klasse *Struct* – Hilfsmethoden


```
boolean compatibleWith(Struct other) {
   return this.typeEqual(other) ||
          (this == Tab.nullType && other.isRefType()) ||
          (other == Tab.nullType && this.isRefType());
}


boolean assignableTo(Struct dest) {
   return this.typeEqual(dest) ||
          (this == Tab.nullType && dest.isRefType()) ||
          (this.kind == Arr && dest.kind == Arr &&
          dest.elemType == Tab.noType);    // für len-Funktion
}
```